SANREM CRSP Phase IV Concept Paper

06/15/09

Phase IV Research Theme:

After consulting with USAID-Washington, USAID Missions, and a large number of other SANREM stakeholders around the world, the following research theme was selected for SANREM Phase IV:

Increasing smallholder food security through the introduction of conservation agriculture production systems (CAPS)

The new CAPS knowledge and technological innovations generated for sustainable rainfed crop and livestock systems will address economic and social (including gender) viability, soil quality, water productivity, and other ecosystem services issues. For the purposes of the concept paper, smallholders are loosely defined as agricultural producers in developing countries whose farm units are managed primarily by family labor, whose cultivated land holdings are relatively small (<1 ha for high population density areas with favorable production conditions to 10 ha or more in semi-arid regions), and which currently employ few external inputs. Targeted production systems will be in both degraded and productive lands of major agro-ecosystems dominated by rainfed agriculture in ***food-insecure*** areas of East, West, and Southern Africa, South and Southeast Asia, Latin America, and the Caribbean. The purpose of the proposed research is to:

- develop sustainable conservation agriculture technologies and practices that increase food production in existing smallholder staple crop production systems,
- demonstrate that these systems are adoptable and economically viable for smallholders,
- demonstrate that these systems enhance the productive capacity of smallholder soils, and
- demonstrate that these systems enhance ecosystem services through improvements in soil quality that promote carbon sequestration, reduce soil erosion, and reduce risks associated with climate change through improved water management and productivity.

The ultimate goal is to improve smallholder food security in each targeted region through the development and dissemination of new technologies and knowledge.

We take as given that improving soil quality is integral to building the sustainable and productive agricultural systems required to achieve the Millennium Development Goal (MDG) of eradicating extreme poverty and hunger. The technical issue is how to assure that soil carbon and inputs of other nutrients to the soil exceed losses due to erosion, mineralization, volatilization, crop/animal harvest, and leaching. There is abundant evidence from around the world indicating that the general and wide-spread use of short-term "soil mining" practices has produced severe soil degradation and low levels of soil organic matter. The resulting soil degradation has resulted in poor responses to improved seed, fertilization, and water management practices developed through the green revolution. This, in turn, has led to an accelerated deteriorating cycle of increased poverty and food insecurity. We need to reverse this cycle to achieve the MDG target to "halve, between 1990 and 2015, the proportion of people whose income is less than $1 a day". To do so, we must improve smallholder agricultural

productivity through the development and implementation of sustainable smallholder production systems, which improve soil quality and which can take advantage of green revolution technologies. We need a new green revolution in staple crops production technology for rainfed, smallholder production systems.

Research on conservation agriculture technologies and practices over the past decades has demonstrated significant productivity increases and conservation benefits for large-scale mechanized agriculture around the world. However, the benefits and lessons learned have not translated readily to smallholder agriculture, particularly as practiced in many developing countries. Given the greater management intensity required by these practices, local innovation and adaptation must play a central role in the development of appropriate Conservation Agriculture Production Systems (CAPS). Successful farm-level adoption has also been linked to innovations in input and output markets. Local champions (such as providers of no-till drills or herbicides, NGOs, farmer organizations, and highly motivated researchers) with a vested interest in the outcome have played a critical role. However, the literature suggests that successful widespread adoption of conservation agriculture by smallholder farmers has yet to be achieved.

The SANREM CRSP program is organized around five landscape systems that intersect and interact to affect sustainable agriculture and natural resource management: field, farm, watershed, ecosystem, and policy/market. These systems are differentiated by the type of decision maker, scale of activities, and predominant incentives. The extent to which decision makers and incentives differ has important implications for many aspects of SA & NRM, including the appropriate types of technologies and practices, and optimal innovation strategies. During SANREM CRSP Phase III, LTRAs were required to conduct research across at least three of the five landscape systems. Although all landscape systems are important as SANREM CRSP Phase IV LTRAs develop strategies for local innovation, testing, and adoption, the main research focus will be on those system components and cross-scale factors related to smallholder productivity and soil quality restoration at the field/farm scale. Specifically, LTRAs will develop and demonstrate locally sustainable CAPS for smallholder rainfed crop production systems that improve food security and restore the productive capacity and ecosystem services of degraded agricultural lands. These agro-sylvo-pastoral production systems must include a substantial component of staple crop production. The challenge for this research effort is twofold:

(1) develop appropriate CAPS technologies adapted to targeted rainfed staple crop smallholder production systems; and
(2) identify effective mechanisms and strategies through which smallholders can transition to improved production systems.

SANREM CRSP Phase IV research will seek to identify and optimize locally appropriate CAPS that will:

- maintain to the extent possible a year-round soil cover provided by residues from previous crops and/or a cover crop intended to improve food production and soil quality.

- minimize soil disturbance by tillage and use tillage only when required for pest control and/or amelioration of undesirable soil conditions that cannot otherwise be corrected in a timely manner.
- utilize crop rotation systems, adapted to local socioeconomic and environmental conditions, that improve soil quality/health and control agricultural pests. The rotation system must include a principal staple crop of the research region.
- utilize integrated pest management (IPM) options to minimize pesticide use for pest and weed control, improve profitability, and minimize potential environmental consequences.
- utilize integrated nutrient management (INM) techniques, using organic and/or inorganic fertilizers to improve agricultural productivity, profitability, and soil quality.

The Collaborative Research Support Program (CRSP)

It is useful to recall the particular institutional vision and framework of USAID's Collaborative Research Support Programs and how this shapes SANREM CRSP implementation. The Collaborative Research Support Program (CRSP) was created in 1977 to engage the capacities of the US Land Grant and other eligible universities in addressing the needs of developing nations worldwide while also contributing to US food security and agricultural development. CRSP research is applied research that is "to achieve the mutual goals among nations of ensuring food security, human health, agricultural growth, trade expansion, and the wise and sustainable use of natural resources". In the case of SANREM CRSP Phase IV, this translates into an applied research, education, and outreach focus on improving smallholder food security through the development of conservation agriculture farming systems for smallholders that increase agricultural productivity and improve soil quality and associated environmental services.

CRSP research is applied research and knowledge dissemination conducted in collaboration with host country scientists and decision-makers for the economic, social, and environmental well-being of developing country populations. The approach is collaborative and implies collaboration between US universities and host country public institutions and other host country and international partners. It is also a participatory approach where all stakeholders have a role in contributing to problem identification, research design and implementation, and to the final research and development outcomes. All applications must include strong partnerships between US universities and host country public institutions (universities, national research institutes, and ministries) and additional partnerships with nongovernmental organizations (NGOs), International Agricultural Research Centers (IARCs), and the private sector as appropriate. Local community participation is also expected. Without the insights and contributions of local user groups successful adoption and dissemination of developed technology is unlikely.

Host country capacity building is a critical component to the CRSP program. Capacity building is accomplished through long-term degree training in US and host country universities, research sabbaticals for host country and US scientists, as well as through short-term conferences, workshops, seminars, and field days designed to disseminate CRSP generated knowledge. While the principal goals of CRSP efforts are applied research and scientific capacity building, institutional capacity building for sustaining host country scientific research, science-based policy and decision-making, enhancing local innovation, and introducing improved agricultural and natural resource management practices into farmer fields and communities are also important.

Research Program Design

The SANREM CRSP Phase IV research program involves two major activities: Long-Term Research Awards (LTRAs) and Cross-Cutting Research Activities (CCRAs). LTRA recipients will identify, investigate, and develop new technologies or combinations of existing technologies that will increase crop yields while enhancing soil quality. These CAPS must be adapted to local agro-ecozones and socioeconomic systems through researcher- and farmer-managed field trials involving user groups and consistent with local input and output networks. Phased introduction and dissemination strategies to demonstrate local impact are expected. CCRAs are Management Entity (ME) driven activities, which synthesize selected cross-cutting themes (economic analysis, gendered knowledge, soil quality, technology networks, and ecosystem services) in collaboration with the core program of regional LTRAs. The CCRAs using data collected from the LTRA sites will highlight a few of the key themes that can be generalized globally while each LTRA focuses on researching the technological package(s) and implementation strategy(s) adapted to their locally driven program. As specialized opportunities or emerging issues arise and if funds allow, additional Special Opportunities Activities (SOAs) may be implemented.

Long-Term Research Awards (LTRA)

The goal of each Long-Term Research Award (LTRA) is to increase smallholder productivity through the development and demonstration of sustainable CAPSs that promote food security. LTRA activities are two-pronged. A locally adapted technology or set of practices that leads to improved smallholder productivity and soil quality must be developed and its viability among smallholders demonstrated. Appropriate field research may be conducted in both researcher and farmer controlled fields and systems. Although we expect each LTRA to make a direct impact on smallholder productivity and soil quality among a targeted group of farmers, we realize that constraints to CAPS innovation and sustainability among smallholders reside at other system levels. Factors facilitating or constraining introduction of those technologies and practices must be identified and a viable methodology for maintaining sustainable performance demonstrated. This will most likely involve working with farmer organizations in the community and developing support through policy and market systems.

Each LTRA team will include a minimum of one US biophysical scientist and one social scientist each matched with a collaborating host country partner. These scientists are expected to bring world-class knowledge and experience to bear on local smallholder productivity and soil quality issues. The specific CAPS research problem to be addressed will be identified in collaboration with host country partners and stakeholders (men and women farmers, private sector (input and output) and government agencies, etc.). The research activity should be designed to be complementary to and supportive of SANREM cross-cutting themes (discussed below).

Core LTRA research themes are expected to revolve around the testing and adoption of locally relevant practices involving minimum tillage, soil cover, and rotations and focus on issues such as, traditional practices for accounting for within field variability; crop/livestock practices for re-cycling nutrients; soil quality/biodiversity monitoring; water productivity; disease, weed and insect pest management; forage/pasture needs; and/or market-led intensification. Technological adaptation that addresses issues of equity and access for smallholders is critical, as is adaptation that takes into account equitable transitions in the gender division of labor and well-being.

LTRA PIs are expected to develop an approach that considers incentives and opportunities for diverse local innovation strategies. Institutions and policies need to be identified, and where possible promoted, for creating and disseminating the new knowledge and skills (from Farmer Field Schools to new university curricula). Building on links to local knowledge nodes (i.e., national extension, research institutes, universities, input suppliers, Landcare, Ecoagriculture, or other locally based CA NGOs) is encouraged.

Funding for each LTRA is projected to be up to $270,000 per year for five years with a comprehensive evaluation at year three to determine continuation of project funding. Proposed activities must leverage funding through partnerships with other organizations and show a minimum of 25% cost-share on total funding.

There will be at least seven LTRAs with at least one LTRA in each region listed below. Each LTRA will focus on an existing major farming system characteristic of its region. Host country partners and research sites must be situated in countries with: USAID missions/programs, significant food insecurity, and social/political stability required for quality research. Priority countries for each region are indicated in parentheses below but applications are also possible for other countries if they meet the three criteria above.

- West Africa (e.g., Ghana, Liberia, Mali, Senegal)
- East Africa (e.g., Burundi, Ethiopia, Kenya, Rwanda, Southern Sudan, Tanzania, Uganda)
- Southern Africa (e.g., Angola, Madagascar, Malawi, Mozambique, Zambia)
- South Asia (e.g., Bangladesh, India, Nepal, Sri Lanka)
- Southeast Asia (e.g., Cambodia, Indonesia , Laos, Philippines)
- South America (e.g., Bolivia, Ecuador, and Peru)
- Caribbean or Central America (e.g., Dominican Republic, Guatemala, Haiti, Honduras, Nicaragua, Panama, El Salvador)

The range of expected outcomes of the technologies and practices developed and demonstrated through this research program are:

- increased agricultural productivity and food security through improved cropping systems that contribute to and take advantage of improved soil quality and fertility
- increased soil organic matter levels required for effective utilization of agricultural inputs to levels that are characteristic of high-quality, resilient, and productive soils
- improved agricultural water productivity through decreased runoff and soil evaporation, and increased infiltration and soil moisture storage in the root zone to reduce risks associated with drought and climate change
- reduced net emission of greenhouse gases into the atmosphere through reductions in losses of soil carbon and nitrogen, and increased sequestered carbon levels in soils
- increased quantity and quality of food for improved farm household nutrition
- improved provisioning (water supply), regulating (climate and flood control), and supporting (nutrient cycling, pollination) ecosystem services
- increased and sustainable incomes leading to better nutrition, health, and education levels for all farm household members

- improved input and output market functioning required to support wide-scale CAPS adoption while reducing short-term risk for smallholders, and
- enhanced gender equity and empowerment of women (bargaining position, application of women's knowledge, recognition of their contributions).

Minimum Award Requirements

All applications must meet the following minimum requirements. Each LTRA must:

- Allocate at least 50% of funding to support research and capacity building of host country partners.
- Support at least two graduate students per year in the US (at least one from the host country) and their thesis research must be a component of the identified research problem. Due consideration for gender balance of students is expected.
- Obtain J-1 visas through TraiNet for all non-resident students supported by SANREM for study in the US.
- Budget for and collaborate with Cross-Cutting Research activities (see below).
- Collect data on performance monitoring indicators (see attached list) and report by August 31 each year.
- Provide a minimum of 25% cost-share of total non-cost share excludable project funding.
- Include a plan to integrate gender into the research program that specifies how gender relations affect the achievement of sustainable results and how proposed results will affect the relative status of men and women.

Only proposals meeting these requirements will be considered for funding.

Cross-Cutting Research Activities

Each LTRA will collaborate with and contribute to cross-cutting research activities (CCRAs) managed by a Lead-PI designated by the ME. In contrast to the in-depth, locally adapted LTRA research, the purpose of the cross-cutting themes research is to synthesize selected findings globally. Each CCRA will involve a standardized research protocol developed by the designated CCRA leader in collaboration with the LTRA PIs that will be integrated with LTRA activities. To the extent possible, baseline needs for the various CCRAs will be streamlined with LTRA data collection activities. Synthesized comparative findings of the CCRAs will be analyzed and broadly adaptive knowledge generated for:

- Economic analysis
- Gendered knowledge
- Soil quality
- Technology networks

Direct funding for CCRAs will be used primarily to support graduate students and international travel. Funding for most CCRA data collection will be integrated with each LTRA's baseline research funds.

Economic and Impact Analysis CCRA

This activity will coordinate economic analyses and impact assessments among the LTRAs and provide leadership for developing a common methodology for evaluating the economic costs and benefits of CAPS adoption. The economic challenges to CAPS adoption are probably the most formidable obstacle that will confront LTRAs and their collaborating host country partners. While the benefits to participating smallholder farmers and their families are time savings (e.g., land preparation, weeding) and long-term increases in soil fertility, erosion control, etc., that result in greater production and food security, there are also substantial short-term costs of adoption (e.g., applications of herbicides, soil amendments, specialized equipment, risk and uncertainty associated with new, intensified management systems). Additional benefits (e.g., ecosystem services including carbon sequestration, reduced siltation of streams, recharged aquifers) accrue to higher-level systems. The relative importance, magnitude, and distribution of benefits and costs will likely vary widely over the geographical distribution of production systems covered by the LTRAs.

However, in order for wide-scale adoption to occur, the fundamental economic research problem remains the same in all regions: what farm-level production system(s) and sequencing of CAPS elements will minimize smallholder costs and risks while maximizing benefits and adoption? This CCRA will assist the LTRAs in developing a common baseline survey and methodology for addressing this general question. It will concentrate initially on assisting in the gathering of data and knowledge required to develop representative 'whole farm' models of the targeted areas to facilitate economic analyses and later, to the extent possible, expand the analysis to the higher landscape levels and economic impact assessment. It is expected that the resulting comparative analysis across LTRAs will provide significant insight into general strategies and economic indicators that promote wide-scale adoption of CAPS.

Goal: Identify farm-level production system(s) and sequencing of CAPS elements that will minimize smallholder costs and risks while maximizing benefits and adoption.

Research questions:

- What are the economic costs and benefits associated with current smallholder farmer production system(s) practice(s)?
- What are the costs and benefits of incremental CAPS changes in cropping systems/practices and related animal and forestry sub-systems?
- What is the 'optimal' system and is there an optimal economic sequencing of CAPS elements?
- What are the broader economic and social impacts of wide-scale CAPS adoption?
- Are subsidies required to bring about CAPS changes? What elements, level, timing?

Gendered Knowledge CCRA

The ultimate success of the individual LTRAs will influenced by how well they incorporate gendered knowledge and women's needs in the development of site specific CAPS. Women often possess specialized agricultural knowledge including areas such as seed selection, soil fertility and crop management practices. In addition, women are key to guaranteeing nutrition and food security for the household and to the generational transmission of agricultural and

ecological knowledge. Consequently, women are essential to understanding the complexities of local production systems and to developing sustainable CAPS. While women may not be the formal decision-makers in household or community institutions, their full participation in the development and evaluation of proposed CAPS is required since CAPS will involve their labor and a reallocation of their resources. Women have knowledge and responsibilities that differ from men's and which can provide incentives (or disincentives) for their participation in CAPS.

The gender CCRA will assist the LTRAs in developing a set of common baseline survey questions and impact indicators for use by the individual LTRAs and by the gender CCRA in conducting a comparative analysis of gender related factors across LTRA sites to identify gender related practices and conditions that promote or hinder the successful adoption of CAPS.

Goal: Identify gender related factors that contribute to the success or failure of CAFS across sites and suggest gender related practices and policies that can be employed to improve the success of CAPS and reduce inequities between women and men.

Research questions*:*

- What gender-based knowledge and practices will impact CAPS technology development and adoption?
- How do women's control of, responsibility for, and access to productive spaces affect their participation in proposed CAPS?
- What strategies are recommended to ensure mobilization and recognition of women's contributions to CAPS?

Methodology: Conduct focus group discussions, structured and unstructured interviews, and participatory mapping. Inventory existing gender-based knowledge and associated spaces. Identify critical nodes in the local knowledge systems/commercial exchange relations. Map areas of intervention. Assess changes. Develop recommendations for policy interventions and further research.

Soil Quality CCRA

The principal goal of CAPS is to enhance land productivity through improved crop response to agricultural inputs (e.g., improved seed, fertilizer, and water management) and to reduce risks and costs due to climate variability and crop pests. In CAPS, soil quality is improved largely through the accumulation of organic matter in the root zone. The increasing soil organic matter improves the water and nutrient holding capacities of soil; improves soil structure and aeration, which creates a more favorable root zone environment for most crops; and increases infiltration, which reduces surface runoff and soil erosion. Conversion of local conventional management of cropland to CAPS increases the soil organic matter over time until a new soil organic matter equilibrium is reached, which is dependent on site specific soils, climatic and management factors. During this period of soil organic matter accumulation, carbon is sequestered in the soil, green house gas emissions decrease, and CAPS are a sink for atmospheric carbon and thus reduce green house gas emissions.

Goal: The soil quality CCRA will conduct a comparative analysis of the effects of CAPS across LTRA sites to assess the likely impacts of large-scale adoption of CAPS on soil quality, soil productivity, carbon sequestration, and the potential for and implications of carbon sequestration payments to smallholders engaged in CAPS that sequester soil carbon.

Research Questions:

- Do CAPS improve soil quality as indicated by changes in soil carbon/organic matter, plant available nutrient levels, plant available water, soil bulk density/porosity, and crop yields over time over time?
- What are carbon sequestration rates in CAPS systems?
- What is the potential of soil carbon sequestration payments for smallholders and how could such programs be implemented?

Methodology: Primary data collection for the Soil Quality CCRA will be through the LTRAs, which will collect the following data from both researched CAPS and traditional cropping system control fields: fertilizer and pesticide applications (composition, rates, and dates of applications); soil N, P, K, and micronutrient levels; soil pH, carbon, bulk density/porosity; estimated soil cover before and after each field operation; and water productivity estimated from precipitation, soil moisture, evapotranspiration estimates, and crop yield data. Some of these analyses will be done by the Soil Quality CCRA research team on soil samples provided by the LTRAs if the analyses are not a component of the LTRA research plan.

Technology Networks for Sustainable Innovation CCRA

The transfer of research findings from our LTRAs to farmers is critical to achieving sustainable impacts on rural livelihoods and natural resource stewardship. In order to determine how research findings enter the knowledge networks fostering technological change for sustainable agriculture, this research examines methods of communication and market networks tracing information and product flows, adoption and policy decisions, and power relations.

Implemented in collaboration with the LTRA teams, this activity will:

- Identify and survey network members (sample design would involve working in snowball fashion starting at a set of structurally diverse points – farmer leaders, input and output market actors, and government service providers; survey data collected includes demographic characteristics, network linkages, and levels and types of knowledge).
- Develop an actor linkage matrix and maps for workshop networking exercises and analysis (this would provide feedback about who knows what and who would be most likely to transmit what types of information/knowledge).
- Determine priority knowledge transmission points; key constraints; knowledge networks; and knowledge leaders who would be most likely to lead changes.

As a result, a common set of metrics across projects will be established for technology networking leading to widespread and sustainable innovation and adoption of CAPS technologies.

Special Opportunity Activities (SOA):

A competitive Special Opportunity Activities (SOA) program (up to $100,000/year) will be implemented to address emerging opportunities. For example, if SANREM is fully funded, and funds are available for Special Opportunity Activities, there might be a Climate Change SOA during the third to fifth years to quantify the potential impacts of different levels and qualities of CAPS adoption developed through the LTRAs on carbon sequestration and reductions in greenhouse gas emissions in each LTRA region. The SOA would also assess the effects of the developed CAPS on agricultural productivity and resilience to climate change for each LTRA. Another SOA could be focused on assessing the impacts of SANREM CRSP Phase III interventions. Special Opportunity Activities could also be used to expand or initiate other regional or cross-cutting activities and unused funding may also serve as a hedge to protect the LTRAs and CCRA funding if SANREM Phase IV is not fully funded by USAID.

USAID Performance Monitoring

The SANREM CRSP is part of USAID's overall program to increase food security and rural livelihoods in developing countries. In the interests of accountability, SANREM is expected to document progress toward achievement of USAID development objectives. In order to do so, all activities will use the following indicators, as appropriate to their research activities, as measures of research progress. The indicators are adapted from the USAID Initiative to End Hunger in Africa (IEHA) and the Foreign Assistance Framework indicators.

Performance monitoring indicators

Beneficiaries

- Increases in smallholder income
- Improved nutrition of smallholder families (increase in caloric and protein intake)
- Health benefits (reduction in malnourishment)
- Number of rural households benefiting directly from interventions
- Number of vulnerable households benefiting directly from interventions
- Number of partner organizations and active institutional members of those partner organizations
- Number of agriculture-related firms benefiting directly from interventions
- Number of producer organizations, water user associations, trade and business associations, and community-based organizations assisted/benefiting
- Number of women's organizations/associations assisted/benefiting
- Number of new public-private partnerships formed/benefited
- Number of ongoing public-private partnerships assisted/benefited

Training

- Male participation in short-term training
- Female participation in short-term training
- Male participation in long-term training

- Female participation in long-term training

Technologies

- Increase in crop yields
- Decrease in production costs
- Technologies under research
- Technologies being field tested
- Technologies available for transfer
- Hectares under new technologies
- Number of farmers adopting new technologies
- Number of processors adopting new technologies
- New surveillance systems

Policy development

- Policy studies undertaken
- Policy studies disseminated
- Number of institutions/organizations assessed
- Number of institutions/organizations undertaking capacity/competency strengthening as a result of SANREM assistance
- Number of institutions/organizations mature/viable in the competency areas strengthened as a result of SANREM assistance
- Number of policy reforms/regulations/administrative procedures presented for legislation/decree as a result of SANREM assistance
- Number of policy reforms/regulations/administrative procedures prepared with SANREM assistance passed/approved
- Number of policy reforms/regulations administrative procedures passed for which implementation has begun with SANREM assistance
- Number of policy reforms/regulations/administrative procedures drafted and presented for public/stakeholder consultation as a result of SANREM assistance
- Number of policies/regulations/administrative procedures analyzed as a result of SANREM assistance

Recommended Readings:

NRC, 2008. Emerging Technologies to Benefit Farmers in Sub-Saharan Africa and South Asia. National Research Council of the National Academies, National Academies Press, Washington, DC. 296p. Available at: http://www.nap.edu/catalog.php?record_id=12455

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